



# **JAI HIND COLLEGE**

Basantsing Institute of Science & J. T. Lalvani College of Commerce  
and Sheila GopalRaheja College of Management.

*Empowered Autonomous*

"A" Road, Churchgate, Mumbai - 400 020, India

**Affiliated to  
University of Mumbai**

**Bachelor of Science**

**Program: Biotechnology**

**Choice Based Credit System (CBCS) under NEP-2020  
With effect from the academic year 2023-2024**

**Syllabus as approved by Statutory  
Committees**

LOCF Document

## Credit Framework

### Types of Courses

S. No.	Type of Course	Learner Category
1.	Major	Biotechnology Major
2.	Minor	Biotechnology Major
3.	OE	Biotechnology Major
4.	SEC	Biotechnology Major
5.	VSC	Biotechnology Major
6.	AEC	Biotechnology Major
7.	VEC	Biotechnology Major
8.	IKS	Biotechnology Major

### Number of courses and credits

Type of Course	Number offered of course	Credits of each (Theory + Practical)
Major	02	8 (6+2)
Minor	02	8 (6+2)
OE	04	8
SEC	02	4 (2+2)
VSC	02	4 (2+2)
AEC	02	4
VEC	02	4
IKS	02	4

## Semester-wise Courses

Semester	Course Code	Course Title	Type of Course	No. of Credits
I	JUSBT-DSC101	Concepts in Biotechnology I	Major	3
I	JUSBT-DSCPR101	Practical of Concepts in Biotechnology I	Major Practical	1
II	JUSBT-DSC201	Concepts in Biotechnology II	Major	3
II	JUSBT-DSCPR201	Practical of Concepts in Biotechnology II		1
I	JUSBT-MIN101	Bioorganic Chemistry I	Minor	3
I	JUSBT-MINPR101	Practical of Bioorganic Chemistry I	Minor Practical	1
II	JUSBT-MIN201	Bioorganic Chemistry II	Minor	3
II	JUSBT-MINPR201	Practical of Bioorganic Chemistry II	Minor Practical	1
I	JUSBT-OE101	Entrepreneurship	OE	2
I	JUSBT-OE102	Soft Skill development I	OE	2
II	JUSBT-OE201	IPR	OE	2
II	JUSBT-OE202	Soft Skill development II	OE	2
I	JUSBT-SEC101	Microbial Diversity and Model Organisms	SEC	2
II	JUSBT-SEC201	Biostatistics I	SEC	2
I	JUSBT-VSC101	Fundamental Techniques in Biotechnology I	VSC	2
II	JUSBT-VSC201	Fundamental Techniques in Biotechnology II	VSC	2
I	JUSBT-AEC101	Communication Skills in English I	AEC	2
II	JUSBT-AEC201	Communication Skills in English II	AEC	2

I	JUSBT-VEC101	Ecosystem and Conservation Science	VEC	2
II	JUSBT-VEC201	Epidemiology and Sustainability	VEC	2
I	JU-IKS(GEN)101	Indian Knowledge System (Generic)	IKS	2

### Assessment Methods / Evaluation Scheme

COURSE CODE	TOPIC	SEE	Internal Assessment	Practical
JUSBT-DSC101	Concepts in Biotechnology I	50	25	--
JUSBT-DSCPR101	Practical of Concepts in Biotechnology I	--	--	25
JUSBT-DSC201	Concepts in Biotechnology II	50	25	--
JUSBT-DSCPR201	Practical of Concepts in Biotechnology II	--	--	25
JUSBT-MIN101	Bioorganic Chemistry I	50	25	--
JUSBT-MINPR101	Practical of Bioorganic Chemistry I	--	--	25
JUSBT-MIN201	Bioorganic Chemistry II	50	25	--
JUSBT-MINPR201	Practical of Bioorganic Chemistry II	--	--	25
JUSBT-OE101	Entrepreneurship	25	25	--
JUSBT-OE102	Soft Skill Development I	25	25	--
JUSBT-OE201	IPR	25	25	--
JUSBT-OE202	Soft Skill Development II	25	25	--
JUSBT-SEC101	Microbial Diversity and Model Organisms	--	--	50
JUSBT-SEC201	Biostatistics I	--	--	50
JUSBT-VSC101	Fundamental Techniques in Biotechnology I	--	--	50
JUSBT-VSC201	Fundamental Techniques in Biotechnology II	--	--	50
JUSBT-AEC101	Communication Skills in English I	25	25	--

<b>JUSBT-AEC201</b>	Communication Skills in English II	25	25	--
<b>JUSBT-VEC101</b>	Ecosystem and Conservation Science	--	50	--
<b>JUSBT-VEC201</b>	Epidemiology and Sustainability	--	50	--
<b>JUSBT- IKSGEN101</b>	Indian Knowledge System (Generic)	--	50	--

**Discipline Specific Core Courses – Major Core Courses**

<b>JUSBT-DSC101</b>	<b>Concepts in Biotechnology I</b>	<b>Credits: 3 Lectures/Week: 3</b>
<b>Course description</b>	<p>The course highlights the basic understanding of the field of Biotechnology, its scope and applications. The Laws of Mendelian Genetics will be understood in detail using suitable examples. The course will portray and illustrate suitable examples on extensions of Mendelian / Non-Mendelian genetics and epistasis. The course also elucidates the various levels of chromosome packaging and their role in gene regulation.</p>	
<b>Learning objectives</b>	<ul style="list-style-type: none"> <li>● Provide an overview of the different applications of Biotechnology in modern industry and research sectors.</li> <li>● Understand Monohybrid, Dihybrid and Trihybrid cross using a Pea plant.</li> <li>● Familiarize students with rediscovery of Mendelian Principles, Pedigree Analysis, and Genetic counseling</li> <li>● Study the structure and organization of the chromosomes and understand the various methods of chromosome staining for identification of the chromosomes.</li> </ul>	
<b>Course Outcomes</b>	<ul style="list-style-type: none"> <li>● Summarize the diverse applications of Biotechnology and in particular the concept of fermentation and application of fermentation in Biotechnology.</li> <li>● Identify and interpret different types of inheritance patterns with prediction of human genetic and phenotypic traits from inheritance patterns.</li> <li>● Describe the structure and organization of the eukaryotic genetic material.</li> <li>● Identify different human karyotypes in terms of being normal or abnormal.</li> </ul>	
	<b>THEORY</b>	<b>(45 lectures)</b>
<b>Sub Unit</b>	<b>Unit – I: Introduction and Applications of Biotechnology</b>	<b>15 lectures</b>
<b>1.</b>	<p>Introduction to Biotechnology</p> <p>Eras of Biotechnology</p> <p>History of Biotechnology, Branches of Biotechnology (Red Biotechnology, White Biotechnology, Blue Biotechnology, Green Biotechnology),</p> <p>Milestones and breakthrough inventions in Biotechnology.</p>	<p>1L</p> <p>1L</p> <p>5L</p>

<p><b>2.</b></p>	<p>Applications of Biotechnology</p> <p>Agriculture: Biotechnological applications, modifications in Plant Quality - Golden rice; Hybrid crops, Molecular Pharming, Plant based vaccines.</p> <p>Environmental Biotechnology: Renewable energy resources, Bioremediation.</p> <p>Fermentation: History, contribution, Design of fermenter, mode of fermentation (Batch, fed, continuous).</p> <p>Examples of different fermentation.</p>	<p>1L</p> <p>3L</p> <p>1L</p>
<p><b>3.</b></p>	<p>Current Advances in Biotechnology</p> <p>COVID-19 World pandemic, discovery of antibiotics, Human Genome Project, Animal Cloning, Gene therapy, Stem cell technology, Techniques used in Biotechnology.</p>	<p>3L</p>
<p><b>Unit – II: Fundamentals of Genetics</b></p>		<p><b>15 lectures</b></p>
<p><b>1.</b></p>	<p>Introduction to Genetics</p> <p>Basic Terminology, Genotype and Phenotype</p> <p>Mendel’s Experimental Design</p> <p>Monohybrid cross and Principle of segregation</p> <p>Dihybrid cross and principle of independent assortment</p> <p>Trihybrid cross</p> <p>Rediscovery of Mendelian Principles</p>	<p>2L</p> <p>5L</p> <p>1L</p>
<p><b>2.</b></p>	<p>Pedigree Analysis- Mendelian Genetics in Inheritance of Humans genetic traits</p> <p>Genetic counseling: Meaning, scope and applications</p>	<p>4L</p>

	Genetics problems	
<b>3.</b>	Extension of Mendelian Genetic Principles:  Incomplete Dominance - Genotype and Phenotype with examples  Codominance - Genotype and Phenotype	3L
	<b>Unit – III: Eukaryotic Genetic Material</b>	<b>15 lectures</b>
<b>1.</b>	Structure of Eukaryotic Chromosomes  Structure of Chromosomes – molecular structure, euchromatin, heterochromatin.  Shapes of metaphase chromosomes – centromeres and telomeres.  Histone and non-histone proteins – structure and role.	2L
<b>2.</b>	Packaging of DNA  Nucleosome structure  Packing of DNA into chromosomes – basic level of packaging, and higher order structures in chromatin.	3L
<b>3.</b>	Cell cycle  Interphase, mitosis and meiosis.	3L
<b>4.</b>	Chromosome study  Unique sequence DNA, repetitive sequence DNA, C value.  Chromosome banding – Types; International nomenclature.	3L



5.	<p>Karyotype Analysis</p> <p>Study of human karyotype – Classification. Study of genetic abnormalities (Turner's Syndrome, Klinefelter's syndrome, Down's Syndrome, Cri-du-chat Syndrome, Philadelphia Syndrome).</p>	4L
	<p><b>Evaluation Scheme</b></p> <p>Internal Assessment (Continuous): 25 marks</p> <p>SEE: 50 marks theory paper according to Bloom's taxonomy.</p>	
<p><b>References:</b></p>	<ol style="list-style-type: none"> <li>1. Dubey R C. (2006). A textbook of Biotechnology. S Chand and Company Ltd.</li> <li>2. Ramavat K. G., and Gopal S. (2009). 12<sup>th</sup> Edition. Comprehensive Biotechnology. 4<sup>th</sup> Revised Edition. S. Chand and Company Ltd. Bhatia S. C. (2005). Textbook of Biotechnology. Atlantic.</li> <li>3. Dorothy Wood (Author), Joanne Willey (Author), Kathleen Sandman (Author). Prescott's Microbiology (2010).</li> <li>4. Gardner E., Simmons M., and Snustad D.P. (1991). Principles of Genetics. 8<sup>th</sup> Edition. John Wiley and Sons Inc.</li> <li>5. Russell P. J. (2016). Essential iGenetics. 3<sup>rd</sup> Edition. Pearson Education.</li> <li>6. Russell P. J. (1998). Genetics. 5<sup>th</sup> Edition. Benjamin/Cummings Publishing Company Inc.</li> </ol>	

<b>JUSBT-PRDSC101</b>	<b>Practical of Concepts in Biotechnology I</b>	<b>Credits: 1 Practical/Week:1</b>
<b>Course description</b>	<b>This course will introduce the students to Biotechnology laboratory and basic instruments. Through this course students will be able to analyse Karyotype, solve problems based on Pedigree and Mendel's test cross.</b>	
<b>Learning objectives</b>	<ul style="list-style-type: none"> <li>● <b>To understand the construction, working principles and applications of common Biotechnology Laboratory equipment</b></li> <li>● <b>To solve problems based on Mendelian Genetics and Pedigree</b></li> <li>● <b>To study Karyotype</b></li> </ul>	
<b>Course Outcomes</b>	<ul style="list-style-type: none"> <li>● <b>Explain principle and significance of Electronic Balance, pH Meter, Water Bath, Hot air Oven, Autoclave, Incubator, Rotary Shaker, Vortex mixer, Centrifuge.</b></li> <li>● <b>Demonstrate mitosis in given biological sample</b></li> <li>● <b>Perform Pedigree analysis and provide basic Genetic counseling</b></li> </ul>	
	<b>PRACTICAL</b>	<b>(30 lectures)</b>
<b>1.</b>	Introduction to Biotechnology laboratory.	
<b>2.</b>	Introduction to glassware used in the Biotechnology laboratory and Good Laboratory Practices.	
<b>3.</b>	Introduction to common laboratory instruments: Electronic Balance, pH Meter, Water Bath, Hot air Oven, Autoclave, Incubator, Rotary Shaker, Vortex mixer, Centrifuge.	
<b>4.</b>	Fermentative production of alcohol.	
<b>5.</b>	Problems on Mendelian Genetics.	-
<b>6.</b>	Pedigree analysis.	

7.	Study of Karyotype	
8.	Study of mitosis	
9.	Visit to a Biotechnology Institute /Industry and report writing	
	<b>Evaluation Scheme:</b> <b>Internal Practical + SEE: 25 marks</b>	

<b>JUSBT-DSC201</b>	<b>Concepts in Biotechnology II</b>	<b>Credits: 3 Lectures/Week: 3</b>
<b>Course description</b>	<p>The student will gain a comprehensive understanding of the structural differences between eukaryotic and prokaryotic cells, including their organelles and cellular components. The learner will also be able to recognize the functional significance of different cellular structures and organelles in eukaryotic and prokaryotic cells. This course explains gene mapping using Conjugation, Map genes using transformation, Transduction, Steps of Lytic cycle, lifecycle of a temperate phage. This course includes examples of Lytic and Prophage. It deals with basic terminologies: Prophage, temperate phage, Prototroph, Auxotroph and also with applications of Plasmids and Transposons. The process of DNA replication in prokaryotes and eukaryotes will be studied.</p>	
<b>Learning objectives</b>	<ul style="list-style-type: none"> <li>● Understand the fundamental differences between eukaryotic and prokaryotic cells, including their ultrastructural features and organelles.</li> <li>● To study basic concepts of Prototrophy and Auxotrophy, methods of conducting conjugation, transformation and Transduction for gene mapping.</li> <li>● To acquaint students with viral Lytic and lysogenic cycles</li> <li>● The course will provide an understanding of the role of various enzymes and proteins in the process of DNA replication.</li> </ul>	
<b>Course Outcomes</b>	<ul style="list-style-type: none"> <li>● Define and identify organelles of prokaryotic and eukaryotic organisms as well as summarize the functions and applications of the organelles with differentiation between prokaryotes and eukaryotes based on their cellular composition.</li> <li>● Describe the terms: Prototroph, Auxotrophs, Complete media, Selective media, Prophage as well as Conjugation, Transformation and Viral mediated transduction</li> <li>● Explain the significance of Plasmids, Codmid and Transposons in Biotechnology and describe the various modes of DNA replication such as along with specific examples.</li> <li>● Compare and contrast the process of DNA replication in prokaryotes and eukaryotes.</li> </ul>	
	<b>THEORY</b>	<b>(45 lectures)</b>
<b>Sub Unit</b>	<b>Unit – I: Prokaryotic and Eukaryotic Ultrastructure</b>	<b>15 lectures</b>
<b>1.</b>	Ultrastructure of Prokaryotic cell (Detailed structure, chemical nature, significance and application) Concept of cell shape and size Glycocalyx: slime layer, capsule, Flagella, pili Cell wall- Gram positive and Gram negative (reference to Archaeobacteria) Cell membrane	1L 1L 2L 2L 1L 1L

	mycolic acids cytoplasm genetic material, and plasmids and its types (In brief) Storage bodies, pigments, and spores	1L 1L 1L 1L 1L
2.	Overview of Ultrastructure of Eukaryotic cell (Structure and function) Cell wall, Plasma membrane, Cytoplasmic matrix Cytoskeletal elements Mitochondria, plastids, Endoplasmic reticulum, Golgi apparatus, ribosomes and Lysosome Nucleus Cilia and Flagella	2L
	<b>Unit – II: Microbial Genetics</b>	<b>15</b>
1.	Prototroph and Auxotrophs (Wild type and nutritional mutants). Use of selective media in isolation of mutants. Use of Antibiotics and Replica Plate Technique to study mutants and wild type.	2L
2.	Introduction to Gene transfer and mapping Techniques  Conjugation: Plasmid vectors -- F+, F-, Hfr, F' strains,  Interrupted mating experiment, Circularity of <i>E. coli</i> chromosome  Transformation: Stepwise process of formation of stable transformants  Transduction: Basic terminology, Types of bacteriophages  Lytic and Lysogenic cycle  Problems based on Gene Mapping techniques	10L
3.	Transposons  Contribution of Barbara Mc Clintok Insertion sequence, Transposable Elements,	03L
	<b>Unit – III: DNA Replication</b>	<b>15 lectures</b>
1.	Introduction: History and structure of DNA.	1L
2.	DNA Replication in Prokaryotes: Semi-conservative DNA replication – outline and Meselson Stahl experiment. Discovery of DNA Polymerases and their role.  Enzymes involved in DNA replication in prokaryotes.	8L

	<p><i>E.coli</i> Chromosome Replication, Okazaki fragments, Nick translation.</p> <p>Rolling Circle Replication - plasmids, phages. Looped rolling circle replication.</p>	
3.	<p>DNA Replication in Eukaryotes: DNA Replication in Eukaryotes – compare with prokaryotes, concept of replicons, experiment to prove semi-conservative replication.</p> <p>Eukaryotic replication enzymes.</p> <p>Replicating ends of a linear chromosome.</p> <p>Assembling newly replicated DNA into nucleosomes.</p>	6L
	<p><b>Evaluation Scheme</b></p> <p>Internal Assessment (Continuous): 25 marks</p> <p>SEE: 50 marks theory paper according to Bloom’s taxonomy.</p>	
<b>References:</b>	<ol style="list-style-type: none"> <li>1. Willey J. M., Sherwood L., Sherwood L. M., Woolverton C. J., Woolverton C. Prescott’s Microbiology. (2010). 8th Edition. McGraw Hill.</li> <li>2. Russell P. J. (2016). Essential iGenetics. 3<sup>rd</sup> Edition. Pearson Education.</li> <li>3. Russell P. J. (1998). Genetics. 5<sup>th</sup> Edition. Benjamin/Cummings Publishing Company Inc.</li> <li>4. Gardner E., Simmons M., and Snustad D.P. (1991). Principles of Genetics. 8<sup>th</sup> Edition. John Wiley and Sons Inc.</li> <li>5. Russell P. J. (2016). Essential iGenetics. 3<sup>rd</sup> Edition. Pearson Education.</li> <li>6. Russell P. J. (1998). Genetics. 5<sup>th</sup> Edition. Benjamin/Cummings Publishing Company Inc.</li> </ol>	

<b>JUSBT-PRDSC201</b>	<b>Practical of Concepts in Biotechnology II</b>	<b>Credits: 1 Practical/Week: 1</b>
<b>Course description</b>	<b>This course will introduce the students to techniques used to stain and observe microbial cell ultrastructure. Further this course will deal with isolation technique and preservation technique for microbial cultures.</b>	
<b>Learning objectives</b>	<ul style="list-style-type: none"> <li>● <b>To stain the microbial cell appendage using special staining techniques</b></li> <li>● <b>To carry out quadrant plate isolation</b></li> </ul>	
<b>Course Outcomes</b>	<ul style="list-style-type: none"> <li>● <b>Demonstrate bacterial cell wall/ capsule/ endospore / lipid granules</b></li> <li>● <b>Perform quadrant plate isolation</b></li> <li>● <b>Construct growth curve for microbial cell culture</b></li> </ul>	
	<b>PRACTICAL</b>	<b>(30 lectures)</b>
<b>1.</b>	Study of Photomicrograph of plant and animal cell organelles	
<b>2.</b>	Cell wall using Chance's method	
<b>3.</b>	Capsule staining using Manewal's method	
<b>4.</b>	Lipid staining using Burdon's method	
<b>5.</b>	Endospore staining using Schaffer and Fulton's method	-
<b>6.</b>	Special staining - Metachromatic granules staining using Albert's	
<b>7.</b>	Isolation of bacteria- quadrant plate method	
<b>8.</b>	Enumeration of bacteria – Spread plate method and pour plate method	
<b>9.</b>	Bacterial Growth Curve	
<b>10.</b>	Problems on Gene Mapping	
<b>11.</b>	Motility test: stab culture technique/ hanging drop method	
<b>12.</b>	Study of mitosis using PDB/ Colchicine treated onion root tips	
<b>13.</b>	Study of giant chromosome	
<b>14.</b>	Visit to a Biotechnology Institute /Industry and report writing	
	<b>Evaluation Scheme: Internal Practical + SEE: 25 marks</b>	

Discipline Specific Core Courses – Minor Core Courses

JUSBT-MIN101	Bioorganic Chemistry I	Credits: 3 Lectures/Week: 3
<p><b>Course description</b></p>	<p>This course introduces the structure, composition, and chemical properties of nucleotides and nucleic acids, including the role of nucleotide base pairing in DNA and RNA molecules. The structure and bonding of carbohydrates and explains significance of these biomolecules in a living cell as well as industry. This course explains the terminologies related to thermodynamics, laws of thermodynamics, their significance and limitations. This course also includes fundamental interactions of water molecules with polar, non-polar and charged molecules, role of water as a reactant in life sustaining biochemical reactions, theories of acids and bases, dissociation of compounds, Henderson-Hasselbach equation, etc. as well as buffering capacities of various biomolecules.</p>	
<p><b>Learning objectives</b></p>	<ul style="list-style-type: none"> <li>● Provide comprehensive exploration of nucleotides and nucleic acids, the fundamental building blocks of genetic information and key players in various cellular processes.</li> <li>● Students will delve into the structure and function of nucleotides and nucleic acids, with a focus on DNA and RNA.</li> <li>● Understand concepts related to Carbohydrates, detailed classification with structure and functions of mono, di and polysaccharides.</li> <li>● Acquaint students with concepts of work, entropy, enthalpy, free energy and laws of thermodynamics and its significance in biological systems and impart the knowledge of properties of water as a solvent, pH, dissociation of acids, bases, working principles of buffers in vitro as well as in living systems (blood).</li> </ul>	
<p><b>Course Outcomes</b></p>	<ul style="list-style-type: none"> <li>● Define Nucleosides, Nucleotides and fundamentals of nucleic acids and summarize the structural differences between types of DNA and RNA</li> <li>● Explain the biological significance and the functions of the nucleotides</li> </ul>	



	<ul style="list-style-type: none"> <li>● Define and classify Carbohydrates, compare and contrast: Epimers of glucose and focus on structure and bonding of different Monosaccharides, Disaccharide and Polysaccharides</li> <li>● Define work, entropy, enthalpy, free energy, etc.</li> <li>● Describe the concepts of hydrogen bonds , cohesive properties, osmolarity, solvent and justify its interactions with polar, non-polar, crystalline and amphipathic solutes and explain the theories of acids and bases along with the working of buffers in vitro (used in laboratory) as well as in vivo (blood and tissues).</li> </ul>	
	<b>THEORY</b>	<b>(45 lectures)</b>
<b>Sub Unit</b>	<b>Unit – I: Nucleotides and Nucleic Acids</b>	<b>15 Lectures</b>
	Nucleotides	3L
	Definition -	
	Structures of Purine and Pyrimidine rings and nucleotides – Including minor purine and pyrimidine bases.	
	Examples of deoxyribonucleotides and ribonucleotides	1L
	Biological functions and significance of nucleotides	
	DNA as genetic material	2L
	Griffith’s Experiment – Transforming principle	3L
	Avery’s Transformation experiment	
	Hershey and Chase’s Bacteriophage Experiment	
	Contribution of Rosalind Franklin- Maurice Wilkins and their X-ray	
	Diffraction studies	1L
	Structure based on Chargaff’s rule & Watson and Crick model	
	Properties of DNA – Includes Reactions and its chemistry	2L
	Forms of DNA	1L
	RNA as genetic material	1L
	i) Types of RNA	
	ii) Structure of each type	1L
	iii)Significance of each type	1L
		2L
	<b>Unit – II: Chemistry of Carbohydrates</b>	<b>15 lectures</b>
<b>1.</b>	General introduction: Definition	6L

	<p>Functions and general classification of carbohydrates</p> <p>Monosaccharides</p> <p>Classification- Aldo and Keto series,</p> <p>C3- C7 molecules (with structures)</p> <p>Concept of Epimers, Optical rotation, D/L forms</p> <p>Pyran and furan ring (Glucopyranose, fructofuranose), Alpha / Beta forms of hexoses.</p>	
2.	<p>Disaccharides- Concept of Glycosidic Bonding</p> <p>Examples of Disaccharides with Structure and bonding in Maltose, Lactose, Sucrose, Cellobiose</p>	4L
3.	<p>Polysaccharides</p> <p>Classification and Examples of Homo and hetero polysaccharides and Storage and structural polysaccharides</p> <p>Structure, bonding and functions of Polysaccharides (Starch, Glycogen, Cellulose, Peptidoglycan)</p> <p>Chemical/Physical Properties of Carbohydrates</p> <p>Chemical Reactions for Detection of Mono, Di and Polysaccharides.</p>	5L
	<b>Unit – III: Thermodynamics, Water and Buffers</b>	<b>15 Lectures</b>
1.	<p>Terms in Thermodynamics</p> <p>System, Surrounding, Intensive and Extensive properties, Types of processes</p>	1L
2.	<p>Energy</p> <p>Enthalpy, Entropy, Gibbs free energy</p>	2L
3.	<p>Laws of thermodynamics</p> <p>First and second law of thermodynamics with mathematical expression</p>	2L

4.	Properties of water Structure of water molecule, Hydrogen bonds, high melting point, boiling point and heat of vaporisation	1L
5.	Chemistry of water Interaction of water with polar solutes, osmolarity, electrically charged solutes, non polar solutes, crystalline solutes and gases	3L
6.	Ionization of water, weak acids and weak bases Ionic product of water, Equilibrium constants, pH scale, Acid dissociation constants, Conjugate acid-base pair, Titration curves	4L
7.	Buffering against pH changes in Biological systems Henderson and Hasselbalch equation, Ionization of amino acid, blood buffer system	2L
	Evaluation Scheme:  Internal Assessment (Continuous): 25 marks  SEE: 50 marks theory paper according to Bloom's taxonomy.	
<b>References:</b>	<ol style="list-style-type: none"> <li>1. Nelson D. L., and Cox M. M. (2008). Lehninger Principles of Biochemistry. 5<sup>th</sup> Edition. W H Freeman and Company.</li> <li>2. VoetD., and Voet J. (2008). Biochemistry. John Willey and Sons, Inc. USA.</li> <li>3. Satyanarayana U. and Chakrapani U. (2007). Biochemistry. 3<sup>rd</sup> Edition. Books and Allied (P) Ltd.</li> <li>4. Russell P. J. (1998). Genetics. 5<sup>th</sup> Edition. Benjamin/Cummings Publishing Company Inc.</li> <li>5. Murray R. (2017). Harper's Illustrated Biochemistry, 27<sup>th</sup> Edition, Lange Publication.</li> <li>6. VoetD., and Voet J. (2008). Biochemistry. John Willey and Sons, Inc. USA.</li> <li>7. Puri, B. R., Sharma, L.R., and Pamanian, M.S (2017). Physical Chemistry, 47<sup>th</sup> Edition, Vishal Publishing Company.</li> </ol>	

<b>JUSBT-PRMIN101</b>	<b>Practical of Bioorganic Chemistry I</b>	<b>Credits: 1 Practical/Week: 1</b>
<b>Course description</b>	This course will introduce students to a chemistry laboratory set up and the do's and don'ts while handling chemicals and glasswares and instruments viz. weighing balance and pH meters. It will further enhance student's ability to independently calculate and make various buffers and chemicals required for chemical analysis. The course also aims at enhancing student ability to perform basic qualitative tests for biomolecules.	
<b>Learning objectives</b>	<ul style="list-style-type: none"> <li>● To learn good practices for a Chemistry lab and familiarize students with safety measures</li> <li>● To understand the concept of preparing standard solutions and stock solutions and buffers of choice at specified pH</li> <li>● To study HH equation and measure pH using pH meter</li> <li>● To perform qualitative analysis of nucleic acids, viz., DNA and RNA and carbohydrates.</li> </ul>	
<b>Course Outcomes</b>	<ul style="list-style-type: none"> <li>● Introduce students to a chemistry laboratory set-up and familiarize with safety measures</li> <li>● Understand the concept of calculating and preparing standard solutions, stock solutions and buffers.</li> <li>● Acquaint students with handling of instruments such as weighing balance and pH Meters.</li> <li>● Ability to perform qualitative analysis for biomolecules such as DNA, RNA and carbohydrates.</li> </ul>	
	<b>PRACTICAL</b>	<b>(30 lectures)</b>
<b>1.</b>	Safety measures, accidents, first aid and good practices in the chemistry laboratory	
<b>2.</b>	Preparation of standard solutions and stock solutions – Molar, Molal, Normal gm/l, ppm.	
<b>3.</b>	Functioning and standardization of pH meter.	
<b>4.</b>	Preparation of buffers	

5.	Qualitative analysis of DNA by DiPhenylAmine method.	
6.	Qualitative analysis of RNA by Orcinol method.	
7.	Qualitative analysis of carbohydrates.	
8	Calibration of instruments- pH meter	
	<b>Evaluation Scheme:</b> <b>Internal Practical + SEE: 25 marks</b>	

JUSBT-MIN201	Bioorganic Chemistry II	Credits: 3 Lectures/Week: 3
<b>Course description</b>	<p>This course aims at introducing students to lipids and the various types of lipids found in biological systems. This unit provides detailed description about categories of lipids and their structural and functional roles in sustaining human life. Students will also get familiarized with the structures of simple and complex lipid molecules.</p> <p>The course explains classification of 20 essential amino acids based on their R-groups and their physical and chemical properties. The students will understand the buffering characteristics of amino acids. Primary, secondary and tertiary organization of proteins and their structural and functional roles will be explained. The different steps done to elucidate the structure of proteins will be described in detail. The course has been designed to introduce students to the basic concepts of enzymology, effect of pH, temperature, enzyme concentration and substrate concentration on enzyme activity and derivatization of Michelis-Menton equation and Lineweaver Burke equation for enzyme activity.</p> <p>Course involves the effect of inhibitors on enzyme activity, role of regulatory enzymes in metabolic pathways, concept of enzyme purification and defining the terms like -yield, fold purification, specific activity and applications of enzymes.</p>	
<b>Learning objectives</b>	<ul style="list-style-type: none"> <li>● Introduce students to various types of lipids and acquaint students with the structures of lipids, their importance and functions in growth and development of living organisms.</li> <li>● To familiarize students with structures and classification of 20 standard amino acids and make them aware about physical, chemical and biological properties of proteins as well as impart knowledge about structural complexity of proteins and steps to elucidate its structure</li> <li>● To introduce students to the basic concepts of enzymology, principles of enzyme kinetics including theory of Michaelis-Menten equation and Lineweaver Burke equation for rate of enzyme catalysed reactions as well as to familiarize them with the effect of various inhibitors on enzyme activity, fundamentals of regulatory enzymes, enzyme purification and applications of enzymes in industry.</li> </ul>	
<b>Course Outcomes</b>	<ul style="list-style-type: none"> <li>● Explain the basic concepts and classification of lipids as well as the structure and functions of lipids in growth and development of living organisms.</li> <li>● Explain basic concepts of enzymology (specificity, activation energy, transition state, reaction intermediates, active sites, etc.) principles of enzyme kinetics (effect of pH, temperature, substrate, enzyme conc. etc.) and Derive Michaelis-Menten equation and Lineweaver Burke equation for rate of enzyme catalysed reactions.</li> <li>● Summarize the concept of enzyme inhibitors, regulation of enzyme activation, mechanism of enzyme action, applications of enzyme in diagnostics and industry and Calculate enzyme purification, yield, specific activity, Enzyme units, etc.</li> </ul>	

<b>Subunits</b>	<b>Unit 1 - Lipids</b>	<b>15 L</b>
1.	Introduction to lipids, biological role and nomenclature of lipids	1L
2.	Classification of lipids: Simple, Complex, Derived and Miscellaneous with examples.	2L
3.	Simple lipids: Fats Oils and Waxes. Rancidity of simple lipids and hydrogenation of oils.	2L
4.	Complex Lipids: i. Triacylglycerols - Structure and functions ii. Phospholipids- Phosphatidylserine, phosphatidylcholine, phosphatidylethanolamine, phosphatidylinositol, cardiolipin Ether linked phospholipids- Plasmalogen with structures and functions iii. Sterols- Cholesterol structure and function iv. Lipoproteins- Types, structure and functions	8L
5.	Storage Lipids: Functional and structural lipids	1L
	Phospholipases; Types and functions	1L
<b>Subunit</b>	<b>Unit 2 - Amino Acids and Proteins</b>	<b>15 L</b>
	<p><b>Amino Acids</b></p> <p>Definition, general formula and Peptide synthesis</p> <p>Classification of amino acids based on polarity of R group and Nutritional classification, non- standard amino acids</p> <p>Properties of amino acids - physical and chemical properties</p> <p>Isoelectric point, concept of isoelectric pH and Zwitterion</p> <p>Titration curve of amino acids (with example)</p> <p>Reactions of Amino Acids, Sorenson's Titration, Ninhydrin Test</p>	8L

	<p><b>Proteins:</b> Classification based on Structure and Functions; Primary, secondary, tertiary and quaternary Structure; N-terminal (Sanger and Edmans Method) and C-terminal Analysis (Enzyme); Protein Denaturation</p>	7 L
<b>Subunit</b>	<b>Unit 3 Enzymes</b>	<b>15 L</b>
	Introduction to Enzymes Definition, Terminologies in enzyme, Classification of enzymes, Nomenclature of enzymes	1L
	Theories of enzyme-substrate complex formation Lock and key model, Induced fit model, Substrate strain theory	1L
	Concept of Coenzymes, Coenzymes as co-substrates, Coenzymes related and not related to B complex vitamins	1L
	Activation energy Standard free energy change, transition state, reaction intermediates, rate-limiting step, reaction coordinate diagrams	2L
	Effect of various parameters on enzyme activity Temperature, pH, Substrate concentration, enzyme concentration and end product concentration	2L
	Enzyme Kinetics Derivation of Michaelis-Menten equation and Lineweaver Burke plot, Concept $V_{max}$ and $K_m$	3L
	Enzyme inhibition Reversible (Competitive, Non-competitive, Uncompetitive and Mixed inhibition) and Irreversible inhibition	2L
	Enzyme regulation Isozymes, Allosteric enzymes, feedback inhibition, reversible covalent modification and proteolytic cleavage	2L
	Applications of enzyme Estimation of analytes, Diagnostics, Therapeutics, Industry	1L
	<p><b>Evaluation Scheme</b> Internal Assessment (Continuous): 25 marks</p> <p>SEE: 50 marks theory paper according to Bloom's taxonomy.</p>	



<b>JUSBT-PRMIN201</b>	<b>Practical of Bioorganic Chemistry II</b>	<b>Credits: 1 Practical/Week: 1</b>
<b>Course description</b>	<b>This course will introduce students to qualitative analysis of biomolecules and practical concepts related to Enzymes</b>	
<b>Learning objectives</b>	<ul style="list-style-type: none"> <li>● <b>To qualitatively detect lipids amino acids and proteins</b></li> <li>● <b>To detect enzyme activity from plant and bacterial samples</b></li> <li>● <b>To determine optimum conditions for enzyme action</b></li> </ul>	
<b>Course Outcomee</b>	<ul style="list-style-type: none"> <li>● <b>Perform qualitative tests for detection of Lipids / amino acids/ proteins</b></li> <li>● <b>Determine saponification value for lipids</b></li> <li>● <b>Separate cooking oil using Soxhlet's apparatus</b></li> <li>● <b>Construct Titration Curve Of Amino Acid and Perform TLC of amino acids</b></li> <li>● <b>Detection of Protease, Urease, Catalase and Dehydrogenase activities in bacteria</b></li> </ul>	
	<b>PRACTICAL</b>	<b>(30 lectures)</b>
<b>1.</b>	Qualitative tests for lipids	
<b>2.</b>	Saponification reaction for lipids	
<b>3.</b>	Separation of cooking oil using Soxhlet's apparatus	
<b>4.</b>	Qualitative tests for Amino acids	
<b>5.</b>	Titration Curve of Amino Acid	
<b>6.</b>	TLC of amino acids	
<b>7.</b>	Qualitative assay of enzymes Amylase, Lipase	
<b>8.</b>	Detection of Protease, Urease, Catalase and Dehydrogenase activities	
<b>9.</b>	Activity of salivary amylase on starch	
<b>10.</b>	Study of the effect of pH on enzyme activity	
<b>11.</b>	Study of the effect of temperature on enzyme activity	
	<b>Evaluation Scheme:</b>	
	<b>Internal Practical + SEE: 25 marks</b>	

<b>JUSBT- OE101</b>	<b>Entrepreneurship</b>	<b>Credits: 2 Lectures/Week: 2</b>
<b>Course description</b>	<p><b>This course summarizes the qualities of a successful entrepreneur, differentiates, and identifies different types of entrepreneurs, describes the process of an entrepreneurial venture and gives significance to motivational factors and barriers in the journey of an entrepreneur.</b></p> <p><b>The course covers the importance of creativity, innovations, Openness Confrontation Trust Autonomy Pro Action Collaboration Experimenting (OCTAPACE) culture and intrapreneurship to sustain an entrepreneurial venture. This course will inculcate logical, critical, and analytical thinking required to formulate business ideas in the field of Biotechnology and allied fields.</b></p> <p><b>This course will further acquaint students with the process of Business planning. Students will learn to frame marketing, operational/production, organizational and financial plans for a successful business. Further, this course will enable students to design business plans for a service provider / product-based company.</b></p>	
<b>Learning objectives</b>	<ul style="list-style-type: none"> <li>● <b>Introduce students to the basic concept of entrepreneurship</b></li> <li>● <b>Make students aware of different motivational factors and barriers in the journey of an entrepreneur</b></li> <li>● <b>Acquaint students with the process of entrepreneurial business development</b></li> <li>● <b>Inspire students to undertake business planning/ come up with an innovative idea or business plan / startup plan</b></li> </ul>	
<b>Course Outcomes</b>	<ul style="list-style-type: none"> <li>● <b>Summarize the qualities of a successful entrepreneur and differentiate and identify different types of entrepreneurs, describe the process and need of an entrepreneurial venture and give significance of motivational factors and barriers in the journey of an entrepreneur</b></li> <li>● <b>Appreciate the importance of creativity, innovations, OCTAPAC culture and intrapreneurship to sustain an entrepreneurial venture</b></li> <li>● <b>Summarize stories of Entrepreneurial ventures and evaluate reasons behind failures of Entrepreneurial business models</b></li> <li>● <b>Design your own Entrepreneurial / innovative business model</b></li> </ul>	

	<b>THEORY</b>	<b>(30 Lectures)</b>
<b>Sub Unit</b>	<b>Unit – I: Introduction to Entrepreneurship</b>	<b>15 lectures</b>
<b>1.</b>	Concept and meaning Qualities of a good entrepreneur Need and significance of entrepreneurship Entrepreneurial Process	5L
<b>2.</b>	Motivating factors and barriers Innovation, Creativity in entrepreneurial endeavor Concept of Intrapreneur Role and responsibilities of an entrepreneur, intrapreneur and Manager	5L
<b>3.</b>	Book review - Journey of Indian and Global Entrepreneurs (Steve Jobs, Kiran Majumdar Shaw, Azim Premji, Dhirubhai Ambani)	5L
	<b>Unit – II: Entrepreneurship Development</b>	<b>15 lectures</b>
<b>1.</b>	Business Planning Process. <span style="float: right;">Marketing</span> Plan, Operational /Production Plan, Organizational Plan and Financial Plan.	7L
<b>2.</b>	Success stories and case study - Indian and global entrepreneurial ventures; understanding journey of Indian and Global Entrepreneurs (Steve Jobs, Kiran Majumdar Shaw, Azim Premji, Dhirubhai Ambani)	4L
<b>3.</b>	Case study - Dealing with failures in Entrepreneurship journey  Designing a business proposal for IT/ E Commerce/ Real Estate/ Pharma / Food/ Biotechnology or any other service or product-based company.	4L
	<b>Evaluation Scheme:</b>  Internal Assessment (Continuous): 25 marks  SEE: 25 marks theory paper according to Bloom’s taxonomy.	
<b>References:</b>	1. Lall M., Sahai S. (2008) Entrepreneurship. 2 <sup>nd</sup> Edition. Anurag Jain for Excel Books Publication. 2. Singh B. D. (2011). Biotechnology. Kalyani Publishers.	

<b>JUSBT- OE102</b>	<b>SOFT SKILL DEVELOPMENT I</b>	<b>Credits: 2 Lectures/Week: 2</b>
<b>Course description</b>	<b>This course creates an understanding and awareness in the student regarding the need for soft skill development. It further provides clear concepts of potential of social media in professional development and its advantages and disadvantages and will build the importance of right ways of job seeking. The course further focuses on building a strong resume as well as helping a student in written communication skills such as Emails, cover letters, and other correspondence.</b>	
<b>Learning objectives</b>	<ul style="list-style-type: none"> <li>● <b>The course helps students understand the importance of soft skill development for employability as well as for professional growth.</b></li> <li>● <b>Use of trending interfaces such as social media will be discussed with specific references to their plus and minus points and guide students on the dos and don'ts while seeking employment.</b></li> <li>● <b>Guide students to develop a strong and positive personal profile</b></li> <li>● <b>Improve written and communication skills including resume writing and SWOT analysis</b></li> </ul>	
<b>Course Outcomes</b>	<ul style="list-style-type: none"> <li>● <b>Improve self-image and branding.</b></li> <li>● <b>Equipped for employability using social media</b></li> <li>● <b>Improve written communications</b></li> <li>● <b>Ability to perform SWOT analysis and inculcating Resume, cover-letters and Email writing skills.</b></li> </ul>	
	<b>THEORY</b>	<b>(30 lectures)</b>
<b>Sub Unit</b>	<b>Unit – I: Professional Development I</b>	<b>15 lectures</b>
<b>1.</b>	Introduction to professional Development, Internship and jobs for Undergraduate students	2L
	Social Appearance and profiling; Image building and Self branding	3L
	Use of Social Media- Instagram, Face book, and others	
	Linkedin profile, Google Scholar, Biotechnika, Times Job, Naukri.com, Monster.com	2L
	Pros and Cons of social media, case studies	1L
	Tutorials	2L

2.	Job search: References, News media and Social Media Importance of understanding job / role description Tutorials	2L 2L 1L
	<b>Unit – II: Professional Development II</b>	<b>15 lectures</b>
1.	SWOT analysis: Use of appropriate language to present candidate profile	2L
2.	Resume Writing Tutorial on resume writing	3L 1L
3.	Professional Communication Skills: Creative Formal writing: Drafting cover letters	2L 2L
4.	E Mails Structuring Emails, Carbon copy, Blind carbon copy, Scheduling mails, Autoreply, E signature	2L
5.	Assignments	3L
	<b>Evaluation Scheme</b> Internal Assessment (Continuous): 25 marks  SEE: 25 marks theory paper according to Bloom's taxonomy.	
<b>References:</b>	1. McKenna C. (2003), Powerful communication skills. Viva Books Private, Limited. 2. Dias L. Communication skills. Vipul Prakashan. 3. Mohan K., and Banerji M. (1990). Developing communication skills. MacMillan India Limited. 4. Hargie O., Dickson D., and Tourish D. (2004). Communication skills for effective management. Palgrave Macmillan.	

<b>JUSBT-OE-201</b>	<b>Intellectual Property Rights</b>	<b>Credits: 2 Lectures/Week: 2</b>
<b>Course description</b>	<p><b>This course helps students learn about intellectual properties, laws protecting different intellectual property and Institutes that govern functionality of intellectual properties. Through this course students will gain knowledge about what can be protected under a given type of intellectual property. This course enables students to understand the process of procuring/ filing/ registering different types of intellectual property with governing authority. Students would also develop and understanding regarding validity of an intellectual property, costs involved and other relevant details. Through this course students will learn about consequences associated with tampering an intellectual property. Case studies will enable students to develop complete insight regarding intellectual property that help protect art / literature / industrial property.</b></p>	
<b>Learning objectives</b>	<ul style="list-style-type: none"> <li>● Generate an awareness related to intellectual property and develop an insight about laws protecting different intellectual property. and Institutes that govern functionality of intellectual properties.</li> <li>● Learn about types of different intellectual property</li> <li>● Understand how to obtain/ file/ register different types of intellectual property and develop insight related to what can be covered under an intellectual property, costs for procurement, and their validity.</li> <li>● Understand consequences of violating an intellectual property using examples</li> </ul>	
<b>Course Outcomes</b>	<ul style="list-style-type: none"> <li>● Give significance to IPR and summarize the agencies dealing with IPR worldwide.</li> <li>● Explain the regulatory aspects of IPR laws in developed and developing countries</li> <li>● Classify and distinguish between different types of IPR and summarize the process for filing of patents, trademarks, and copyrights.</li> <li>● Discuss different types of IPRs citing examples of the same</li> </ul>	
	<b>THEORY</b>	<b>30 Lectures</b>
<b>Sub Unit</b>	<b>Unit – I: Introduction to IPR</b>	<b>15 lectures</b>
<b>1.</b>	<p>Introduction to Intellectual Property</p> <p>Laws governing intellectual property; Agencies For worldwide promotion and protection of intellectual property</p> <p>Paris Convention Treaty (PCT),</p>	5L

	World Intellectual Property Organization (WIPO) - role, Celebration of World Intellectual Property Day, Visionary Innovator European Patent Convention (EPC), TRIPs, WTO, India and TRIPs	
<b>2.</b>	Types and features of different intellectual properties Protecting art and literature through Copyright Act Protecting industrial / Technical / functional property through Patent Act, Trademark Act, Trade secrets Industrial Designs Geographical Indicators Plant Variety Protection	10 L
	<b>Unit – II: Handling Intellectual Properties</b>	<b>15 lectures</b>
<b>1.</b>	Steps to file / procure different types of Intellectual properties -  Patent - Process of filing, Costs, Applicability, Grant duration Trademark Registration process, cost and validity, Salient features of Trademark protection- Terms for correct use Registration of copyright	3L    2L
<b>2.</b>	Case studies related to different types of Intellectual properties Examples of Top Indian Patents Examples of Top Indian copyrights Examples of Top Indian Trade marks Examples of Top Indian Trade Secret Understanding Infringement and related consequences using global example	6L     2L
<b>3.</b>	Assignments	2L
	<b>Evaluation Scheme:</b> Internal Assessment (Continuous): 25 marks  SEE: 25 marks theory paper according to Bloom's taxonomy	
<b>References:</b>	1. Singh B. D. (2011). Biotechnology. Kalyani Publishers. 2. World Intellectual Property Organisation. (2022). WIPO Patent Drafting Manual. 2nd Edition. Geneva: WIPO.	

<b>JUSBT-OE 202</b>	<b>Soft Skill Development</b>	<b>Credits: 2 Lectures/Week: 2</b>
<b>Course description</b>	<b>This course will provide useful information to help a candidate face formal interviews. The various aspects of interpersonal interaction during an interview will be understood using appropriate examples and case studies. This course will provide students to learn and acquaint themselves with presentations skills, public speaking skills, leadership qualities; develop team work spirit and human resource management.</b>	
<b>Learning objectives</b>	<ul style="list-style-type: none"> <li>● <b>Build competency to face interviews and understand the importance of dressing and appearance during a formal interview.</b></li> <li>● <b>Learn the appropriate use of verbal and nonverbal methods of communication.</b></li> <li>● <b>Make students develop skills to do professional presentations and public speaking by way of debate and discussions</b></li> <li>● <b>Develop leadership qualities and develop team spirit</b></li> </ul>	
<b>Course Outcomes</b>	<ul style="list-style-type: none"> <li>● <b>Students will be prepared to face interviews.</b></li> <li>● <b>Students will develop and gain knowledge regarding etiquettes and negotiation skills.</b></li> <li>● <b>Students will gain confidence and develop professional presentation skills</b></li> <li>● <b>Students will develop leadership skills and team spirit by means of group discussions and group activities.</b></li> </ul>	
	<b>THEORY</b>	<b>(30 lectures)</b>
<b>Sub Unit</b>	<b>Unit – I: Professional Development - II</b>	<b>15 lectures</b>
<b>1.</b>	How to face interviews? Virtual and physical interviews. Preparing for Interviews	3L 1L
<b>2.</b>	Interview Etiquettes Formal Dressing Formal Appearance Verbal and Nonverbal communications Art of questioning and negotiation skills	3L 4L 4L
	<b>Unit – II: Social Skill Development</b>	<b>15 lectures</b>
<b>1.</b>	Social communication Skills	2L
<b>2.</b>	How to Ace Formal presentations	1L
<b>3.</b>	Group Discussion do's and don'ts	2L
<b>4.</b>	Developing team spirit through games and activities	2L
<b>5.</b>	Debate and its importance	2L



<b>6.</b>	Inculcating Leadership skills	1L
<b>7.</b>	Team wok Art of delegation	2L
<b>8.</b>	Tutorials	3L
	<b>Evaluation Scheme</b> Internal Assessment (Continuous): 25 marks  SEE: 25 marks theory paper according to Bloom's taxonomy.	
<b>References:</b>	1. McKenna C. (2003), Powerful communication skills. Viva Books Private, Limited. 2. Dias L. Communication skills. Vipul Prakashan. 3. Mohan K., and Banerji M. (1990). Developing communication skills. MacMillan India Limited. 4. Hargie O., Dickson D., and Tourish D. (2004). Communication skills for effective management. Palgrave Macmillan.	

<b>JUSBT-SEC101</b>	<b>Microbial diversity and model organisms</b>	<b>Credits: 2 Practical/Week: 2</b>
<b>Course description</b>	<b>This course will enable students to understand the concept and technique for bacterial enumeration. Through this course students will be able to successfully enrich, isolate, and identify Blue green algae, cyanobacteria and fungi. Students will also learn culturing biological model <i>Drosophila melanogaster</i>.</b>	
<b>Learning objectives</b>	<ul style="list-style-type: none"> <li>● To enumerate microbial cells using micrometer and study the special structures specific for certain bacteria</li> <li>● To examine permanent slides and characterize BGA microscopically and study algae using enrichment method</li> <li>● To examine and make fungal wet mounts</li> <li>● To culture and observe <i>Drosophila melanogaster</i>.</li> </ul>	
<b>Course Outcomes</b>	<ul style="list-style-type: none"> <li>● Introduce students to concept of bacterial enumeration</li> <li>● Acquaint students with techniques for culturing, visualization and identification of cyanobacteria, algae and fungi</li> <li>● Acquire skill of culturing and mounting <i>Drosophila melanogaster</i>.</li> </ul>	
	<b>PRACTICAL</b>	<b>(30 lectures)</b>
<b>1.</b>	Medically and environmentally important microbes <ul style="list-style-type: none"> <li>a. Gram positive Eubacteria with cell walls</li> <li>b. Gram negative Eubacteria with cell walls</li> <li>c. Eubacteria lacking cell walls</li> <li>d. Archaeobacteria</li> </ul>	
<b>2.</b>	General classification and structure of viruses	
<b>3.</b>	Study of permanent slides of BGA	
<b>4.</b>	Direct enumeration technique - Breed's count	
<b>5.</b>	Enrichment of Algae.	
<b>6.</b>	Study of fungi	
<b>7.</b>	Study of milk and yoghurt microflora	
<b>8.</b>	Cultivation of <i>Drosophila</i>	

<b>9.</b>	Identification of male and female <i>Drosophila</i>	
<b>1.</b>	Assignment	
	<b>Evaluation Scheme:</b> <b>Internal Practical + SEE: 50 marks</b>	

<b>JUSBT-SEC201</b>	<b>Biostatistics I</b>	<b>Credits: 2 Practical/Week: 2</b>
<b>Course description</b>	<b>This course will enable students to represent data optimally using the appropriate means of representation. The measures of central tendency and measures of dispersion will be studied.</b>	
<b>Learning objectives</b>	<ul style="list-style-type: none"> <li>• <b>Use the different types of tools available for data representation for different types of data.</b></li> <li>• <b>Understand the measures of central tendency and measures of dispersion.</b></li> <li>• <b>Study the use of MS Excel in data representation, and data analysis.</b></li> </ul>	
<b>Course Outcomes</b>	<ul style="list-style-type: none"> <li>• <b>Represent data in the form of Frequency polygon, Histogram, Line Chart, Bar Chart, and Pie Diagram.</b></li> <li>• <b>Determine the mean, median and mode for a given data set.</b></li> <li>• <b>Determine the Range, Variance, Co-efficient of Variation, Standard Deviation, and Standard Error for a given data set.</b></li> <li>• <b>Use MS Excel for data representation, and data analysis.</b></li> </ul>	
	<b>PRACTICAL</b>	
<b>1.</b>	Classification of data and sources of data.	
<b>2.</b>	Population sampling methods.	
<b>3.</b>	Representation of data using Frequency Polygon, Histogram, Line chart, Bar chart, and Pie Diagram.	
<b>4.</b>	Measures of Central Tendency and Types of variability.	
<b>5.</b>	Measures of Dispersion.	
<b>6.</b>	Biometric analysis for Mean, Median, Mode and Standard Deviation.	
<b>7.</b>	Use of MS Excel for data analysis.	
<b>8.</b>	Assignment.	
	<b>Evaluation Scheme: Internal Practical + SEE: 50 marks</b>	

<b>JUSBT-VSC101</b>	<b>Practical in Fundamental Techniques in Biotechnology I</b>	<b>Credits: 2 Practical/Week:2</b>
<b>Course description</b>	<b>This course is designed to improve the hands-on skill of students in maintaining aseptic conditions in microbiology, different techniques to grow and observe microorganisms.</b>	
<b>Learning objectives</b>	<ul style="list-style-type: none"> <li>● <b>Develop a comprehensive understanding on sterilization techniques.</b></li> <li>● <b>To understand the concept composition and significance of different media for microorganisms.</b></li> <li>● <b>Understand the techniques of staining and observing organism under microscope.</b></li> </ul>	
<b>Course Outcomes</b>	<ul style="list-style-type: none"> <li>● <b>Ability to implement the knowledge of sterilization techniques.</b></li> <li>● <b>Define and apply the concept composition and significance of different media for growing microorganisms.</b></li> <li>● <b>Preparation of slides for staining, observing and identifying organisms under microscope under different magnification.</b></li> </ul>	
	<b>PRACTICAL</b>	<b>(30 lectures)</b>
<b>1.</b>	Sterilization techniques.	
<b>2.</b>	Agents of sterilization.	
<b>3.</b>	Sterilization of laboratory glassware and tools.	
<b>4.</b>	Cultivation of different microorganisms.	
<b>5.</b>	Design and types of culture medium.	
<b>6.</b>	Preparation of media – Nutrient Broth, Nutrient Agar, MacConkey Agar, Sabouraud’s Broth and agar	
<b>7.</b>	Aseptic Transfer technique	
<b>8.</b>	Isolation of microorganisms: T streaking method	
<b>9.</b>	Preservation of microorganisms	

10.	Technique of microscopy.	
11.	Components and working of Simple and Compound microscope	
12.	Staining solutions and techniques in microscopy	
13.	Monochrome staining of bacteria ( <i>Bacillus</i> and <i>E. coli</i> )	
14.	Differential staining- Gram staining	
	<b>Evaluation Scheme:</b> <b>Internal Practical + SEE: 50 marks</b>	

<b>JUSBT-VSC201</b>	<b>Practical in Fundamental Techniques in Biotechnology II</b>	<b>Credits: 2 Practical/Week: 2</b>
<b>Course description</b>	<b>This course is designed to improve the hands-on skill of students in bio analytical techniques using special apparatus and instruments.</b>	
<b>Learning objectives</b>	<ul style="list-style-type: none"> <li>● <b>To understand construction and working of a colorimeter</b></li> <li>● <b>To determine <math>\lambda</math> Max value for colorimetric estimations and verify Beer and Lambert's law</b></li> </ul>	
<b>Course Outcomes</b>	<ul style="list-style-type: none"> <li>● <b>Estimate glucose concentration using DNSA method</b></li> <li>● <b>Study plant pigments using chromatographic technique</b></li> </ul>	
	<b>PRACTICAL</b>	
<b>1.</b>	Construction and working of colorimeter	
<b>2.</b>	Standardization of Colorimeter – Determination of $\lambda$ Max for KMnO <sub>4</sub> / CuSO <sub>4</sub>	
<b>3.</b>	Verification of Beer and Lambert's law.	
<b>4.</b>	Estimation of sugars by DNSA method.	
<b>5.</b>	Separation of plant pigments using paper chromatography	
<b>6.</b>	Study of Hill's Reaction	
<b>7.</b>	Colorimetric study of absorption spectrum of photosynthetic pigments	
	<b>Evaluation Scheme:</b> <b>Internal Practical + SEE: 50 marks</b>	

<b>JUSBT-AEC101</b>	<b>Communication Skills in English I</b>	<b>Credits: 2 Lectures/Week: 2</b>
<b>Course description</b>	Through this course, students will learn about the appropriate usage of words, the importance of grammar, and well-constructed sentences. Reading and comprehension skills will be particularly emphasized on and honed. Writing skills with special reference to Scientific writing will also be learnt.	
<b>Learning objectives</b>	<ul style="list-style-type: none"> <li>● Enhance proficiency in the use of the English language.</li> <li>● Apply basic language skills to different contexts and narratives.</li> <li>● Write quality articles, reports and other literature especially associated with Science</li> </ul>	
<b>Course Outcomes</b>	<ul style="list-style-type: none"> <li>● The student will be able to demonstrate good written and oral communication skills in English.</li> <li>● The student will be well versed with the different modes of reading viz., skimming, scanning, speed reading as required in different contexts.</li> <li>● The student will be acquainted with the different forms of writing including technical, professional, as well as creative writing.</li> </ul>	
	<b>THEORY</b>	<b>(30 lectures)</b>
<b>Sub Unit</b>	<b>Unit – I: Basic Language Skills</b>	<b>6 lectures</b>
	Grammar Articles, prepositions, conjunctions Transformation of Sentences (Simple, Compound, Complex) Tenses Question Tags Direct and Indirect Speech Active and Passive Voice	4L           2L
	<b>Unit – II: Applied Language Skills – Reading Skills</b>	<b>12 lectures</b>
	(Sources of learning: Scientific Journals, Literary Texts, Newspaper Articles, Reports, Technical Literature, Any other relevant source)	



	<p>Reading Skills</p> <p>Reading with fluency and speed</p> <p>Skimming and scanning</p> <p>Identifying relevant information</p> <p>Isolating fact from opinion</p> <p>Understanding concepts and arguments</p> <p>Identifying distinctive features of language</p>	<p>4L</p> <p>4L</p> <p>4L</p>
	<b>Unit – III: Applied Language Skills – Writing Skills</b>	<b>12 lectures</b>
	<p>Essays</p> <p>Field Trip Reports</p> <p>Newsletters</p> <p>Newspaper Report</p> <p>Technical Writing</p> <p>Use of MS Office in Writing</p>	<p>2L</p> <p>2L</p> <p>2L</p> <p>2L</p> <p>2L</p> <p>2L</p>
	<p><b>Evaluation Scheme</b>  Internal Assessment (Continuous) of 25 marks  SEE: 25 marks theory paper according to Bloom’s taxonomy.</p>	
<b>References:</b>	<ol style="list-style-type: none"> <li>1. Barker, Alan. (2010). <i>Improve your Communication Skills</i>. Revised 2<sup>nd</sup> Edition. New York, Philadelphia, and New Delhi: Kogan Press Limited.</li> <li>2. Bellare, Nirmala. (1998). <i>Reading Strategies</i>. Vol. 1 and Vol. 2. New Delhi. Oxford University Press.</li> <li>3. Blass, Laurie, Kathy Block and Hannah Friesan. (2007). <i>Creating Meaning</i>. Oxford: Oxford University Press.</li> <li>4. Buscemi, Santi, and Charlotte Smith. (1994). <i>75 Readings Plus</i>. 2<sup>nd</sup> Edition. New York. McGraw Hill.</li> </ol>	

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5. <http://www.bbc.co.uk/>
6. <http://www.pearsoned.co.uk/AboutUs/ELT/>
7. <http://www.howisay.com/>
8. <http://www.thefreedictionary.com>
9. Allison Gross; Annemarie Hamlin; Billy Merck; Chris Rubio; Jodi Naas; Megan Savage; and Michele DeSilva. *Technical Writing*. Open Oregon Educational Resources. <https://openoregon.pressbooks.pub/technicalwriting/>

<b>JUSBT- AEC201</b>	<b>Communication Skills in English II</b>	<b>Credits: 2 Lectures/Week: 2</b>
<b>Course description</b>	<b>This course will help the learner to improve on their listening skills. Different strategies for listening as required in different occasions will be discussed. Speaking skills for various events and times will be studied.</b>	
<b>Learning objectives</b>	<ul style="list-style-type: none"> <li>● To develop good listening skills through exposure to various contexts.</li> <li>● To create awareness of the barriers to good listening and to adapt ways of being a good listener.</li> <li>● To build competency in spoken English at different occasions.</li> </ul>	
<b>Course Outcomes</b>	<ul style="list-style-type: none"> <li>● The learner will be able to engage in effective and productive communication through good listening skills.</li> <li>● The learner will be able to speak in English fluently as well as confidently at various occasions.</li> </ul>	
	<b>THEORY</b>	<b>(30 lectures)</b>
<b>Sub Unit</b>	<b>Unit – I: Listening Skills</b>	<b>15 lectures</b>
<b>1.</b>	Purpose of Listening Hearing Vs listening, process of listening, types, Barriers to Listening,	2L
<b>2.</b>	Qualities of a Good Listener Active Vs Passive Listening Listening to Conversation (Formal and Informal) Active Listening- an Effective Listening Skill Benefits of Effective Listening Barriers to Listening	6L
<b>3.</b>	Listening to Announcements- (railway/ bus stations/ airport /sports announcement/ Commentaries etc.) Telephonic Communication: Dos and Don'ts Academic Listening (Listening to Lectures) Listening to Talks and Presentations Note Taking Tips, drawing inferences and summarising	7L

	Listening comprehension – Video talks/ Eminent speeches	
	<b>Unit – II: Speaking Skills</b>	<b>15 lectures</b>
<b>1.</b>	General speaking skills Introducing yourself, Describing a person, place, situation, and event, Giving instruction, Making inquiries – at a bank, post-office, air-port, hospital, reservation counter and role play	5L
<b>2.</b>	Occasions for speeches Voice Modulation: Horizons (pitch, tone, volume, modulation) Word stress, rhythm, weak and strong form, pauses, group-sense, falling and rising tones, fluency, pace of delivery, dealing with problem sounds, accent, influence of mother tongue etc. Welcome address Vote of thanks Self-introduction Introducing a speaker or guest at a function	10L
	<b>Evaluation Scheme:</b> Internal Assessment (Continuous) of 25 marks  SEE: 25 marks theory paper according to Bloom’s taxonomy.	
<b>References:</b>	<ol style="list-style-type: none"> <li>1. Anderson, Kenneth. Joan Maclean and Tony Lynch. Study Speaking: A Course in Spoken English for Academic Purposes. Cambridge: CUP, 2004.</li> <li>2. Communication skills. Sanjay Kumar, PushpLata, 2<sup>nd</sup> Edition, Oxford Press, 2015.</li> <li>3. Brilliant Communication Skills. Gill Hasson, 1<sup>st</sup> Edition, Pearson. 2014.</li> <li>4. The Ace of Soft Skills: Attitude, Communication and Etiquette for success. GopalaSwamy Ramesh, 5<sup>th</sup> Edition, Pearson, 2013</li> <li>5. Personality development and soft skills, Barun K Mitra. 2<sup>nd</sup> Edition, Oxford University Press. 2016.</li> <li>6. Soft skill for everyone, Butter Field, 1st Edition, Cengage Learning India pvt.ltd, 2011.</li> <li>7. Soft skills and professional communication, Francis Peters SJ, 1stEdition, McGraw Hill Education, 2011.</li> <li>8. Effective communication, John Adair, 4thEdition, Pan Mac Millan, 2009.</li> <li>9. Bringing out the best in people, Aubrey Daniels, 2ndEdition, McGraw Hill, 1999.</li> <li>10. Bellare, Nirmala. Reading &amp; Study Strategies. Books. 1 and 2. Oxford University Press, 1998.</li> <li>11. Bellare, Nirmala. Easy Steps to Summary Writing and Note-Making. Amazon Kindle Edition, 2020.</li> </ol>	

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<b>JUSBT-VEC101</b>	<b>ECOSYSTEM AND CONSERVATION SCIENCE</b>	<b>Credits: 2 Lectures/Week: 2</b>
<b>Course description</b>	<b>This course will help students to gain an understanding of the foundational concepts of ecology, including levels of organization, ecosystems, biomes, and ecological niches. Participants will explore the various types of ecological interactions, such as competition, predation, parasitism, mutualism, and commensalism, and their significance in shaping species distributions and community structure. This course will acquaint students with the importance of natural diversity. The students will also learn about the biodiversity prevalent in the ecosystem. This course will further enlighten students regarding the steps taken and laws passed for conservation of natural diversity</b>	
<b>Learning objectives</b>	<ul style="list-style-type: none"> <li>● Familiarize students with the fundamentals of ecology and its associated terms.</li> <li>● Equip students with the knowledge of ecological laws and species interactions.</li> <li>● Acquaint students with the concept of natural diversity including biotic and abiotic components</li> <li>● Understanding the legislature and steps taken towards natural resource conservation</li> </ul>	
<b>Course Outcomes</b>	<ul style="list-style-type: none"> <li>● Describe the concept of ecosystem and its related terms</li> <li>● Explain biogeochemical cycles.</li> <li>● Discuss ecological interactions</li> <li>● Explain the concept of natural diversity</li> </ul>	
	<b>THEORY</b>	<b>(30 L) (Total no.) lectures)</b>
<b>Sub Unit</b>	<b>Unit – I: Ecosystem and Ecological Interactions</b>	<b>15 lectures</b>
<b>1.</b>	Natural resources and their profiles - water, soil, air Ecosystem and its Components: Habitat, Niche Biogeochemical Cycles- Carbon, Nitrogen, Phosphorous, Hydrologic Succession in an Ecosystem: Primary, Secondary and Climax	1L 2L 3L 2L
<b>2.</b>	Laws of Ecology: Shelford and Gause Food Web and Food Pyramid - energy flow models Ecological Interactions: Commensalism, Ammensalism, Mutualism, Neutralism, Parasitism, Altruism, Reverse Altruism.	2L 2L 3L

	<b>Unit – II: Natural Diversity and Conservation</b>	<b>15 lectures</b>
<b>1.</b>	Introduction Natural Resources: The abiotic components Biodiversity: The biotic components of 5 major kingdoms	1L
<b>2.</b>	Diversity of Kingdom Monera: archaeobacteria and eubacteria	1L
<b>3.</b>	Diversity of Kingdom protista- Classification of protists	1L
<b>4.</b>	Diversity of Kingdom fungi -Non- terrestrial, Lower terrestrial and higher terrestrial fungal classes and their features.	2L
<b>5.</b>	Algal Diversity- Classification of algal classes and their features	2L
<b>6.</b>	Diversity of Kingdom Plantae - thallophyta, bryophyta, pteridophyta, gymnosperms and angiosperms	2L
<b>7.</b>	Diversity of Kingdom Animalia-basic classification	2L
<b>8.</b>	Conservation of Natural Resources: Conservation of Wildlife, Soil Erosion and Conservation, Environmental Laws: Water Act, 1974, Air Act, 1981, The Wildlife (Protection) Act, 1972, Environment Protection, 1986, Global Summits. Conservation of Biodiversity: Biotechnology in Biodiversity conservation i) Field Gene Banks ii) Seed Banks iii) Pollen Banks iv) DNA Banks v) Germplasm preservation: Cryobiology	4L
	<b>Evaluation Scheme</b> Internal Assessment (Continuous) of 50 marks	
<b>References:</b>	<ol style="list-style-type: none"> <li>Santra S. C. (2011). Environmental Science. 2nd Edition. New Central Book Agency (P) Ltd.</li> <li>Odum E. P., and Barrett G. W. (2005). Fundamentals of Ecology. Thomson Brooks/Cole.</li> <li>Verma P. S., and Agarwal V. K. (1983/2016Rp). Environmental Biology: Principles of Ecology. S. Chand and Company Pvt. Ltd.</li> <li>Willey J. M., Sherwood L., Sherwood L. M., Woolverton C. J., Woolverton C. Prescott's Microbiology. (2010). 8th Edition. McGraw Hill.</li> </ol>	

<b>JUSBT-VEC201</b>	<b>EPIDEMIOLOGY AND SUSTAINABILITY</b>	<b>Credits:2 Lectures/Week: 2</b>
<b>Course description</b>	<b>Students will grasp the fundamental concepts of disease transmission, including the modes of transmission (e.g., direct contact, airborne, vector-borne), factors influencing disease spread (e.g., host characteristics, environmental conditions), and the dynamics of disease outbreaks in populations. Students will develop the ability to analyze and interpret disease data, identify disease patterns, and assess the factors contributing to disease outbreaks.</b>	
<b>Learning objectives</b>	<ul style="list-style-type: none"> <li>● <b>Understand the Principles of Disease Transmission.</b></li> <li>● <b>Analyze Disease Patterns and Outbreaks.</b></li> <li>● <b>Evaluate Strategies for Disease Prevention and Control</b></li> </ul>	
<b>Course Outcomes</b>	<ul style="list-style-type: none"> <li>● <b>Understand factors which affect disease transmission and progression in a population.</b></li> <li>● <b>Application of understanding disease patterns and their outbreaks formulation of strategies for prevention and control</b></li> </ul>	
	<b>THEORY</b>	<b>(30 lectures)</b>
<b>Sub Unit</b>	<b>Unit – I: DISEASE EPIDEMIOLOGY AND ECOLOGY</b>	<b>15 lectures</b>
<b>1.</b>	Epidemiology and its related terms Infection and its types - primary, secondary, nosocomial, atypical, subclinical	2L
<b>2.</b>	Sources of infections- animals, insects, soil and water, food with examples Methods of transmission of infection - contact, inhalation, ingestion, insects, congenital, iatrogenic and laboratory with examples	3L 3L
<b>3.</b>	Epidemiological methods Measuring infectious disease frequency Patterns of infectious disease in a population Emerging and reemerging infectious diseases and pathogens Prevention and control of epidemics	1L 1L 2L 2L 1L
	<b>Unit – II: SUSTAINABILITY AND GREEN TECHNOLOGY</b>	<b>15 lectures</b>
<b>1.</b>	Sustainable development- Meaning, concept and methods. Concept of Carbon footprint and carbon credit	3L
<b>2.</b>	Bioremediation, Phytoremediation and Mycoremediation In-situ bioremediation-bioventing, biostimulation Ex-situ bioremediation- bioaugmentation Types of phytoremediation	6L
<b>3.</b>	Green Chemistry: Introduction and Scope 12 Principles of Green Chemistry Tools of green Chemistry and applications	6L



	<b>Evaluation Scheme</b> Internal Assessment (Continuous) of 50 marks	
<b>References:</b>	<ol style="list-style-type: none"> <li>1. Willey J. M., Sherwood L., Sherwood L. M., Woolverton C. J., Woolverton C. Prescott's Microbiology. (2010). 8th Edition. McGraw Hill.</li> <li>2. B.D Singh, (2010). Biotechnology:expanding horizons. Kalayani Publishers.</li> <li>3. Fulekar M. H. (2010). Environmental Biotechnology. CRCPress.</li> <li>4. Anastas. T.Paul and Warner. C. John. (1998). Green Chemistry; Theory and Practice. Oxford University Press</li> <li>5. Ahluwalia.K.V. (2006). Green Chemistry; Environmentally Benign Reactions. Ane Books India.</li> </ol>	

<b>JU-IKS-GEN101</b>	<b>Indian Knowledge System (Generic)</b>	<b>Credits: 2 Lectures/Week: 2</b>
<b>Course description</b>	<p>The National Educational Policy 2020 (NEP 2020) recommends the incorporation of Indian Knowledge System (IKS) into the curriculum at all levels of education: “The heritage of ancient and eternal IKS and thought has been a guiding light for this Policy. The pursuit of Knowledge (Jñāna), wisdom (Prajñā), and truth (Satya) was always considered in Indian thought and philosophy as the highest human goal. The Indian education system produced great scholars such as Charaka, Susruta, Aryabhata, Varahamihira, Bhaskaracharya, Brahmagupta, Chanakya, ChakrapaniDatta, Madhava, Panini, Patanjali, Nagarjuna, Gautama, Pingala, Sankardev, Maitreyi, Gargi and Thiruvalluvar, among numerous others, who made seminal contributions to world knowledge in diverse fields such as mathematics, astronomy, metallurgy, medical science and surgery, civil engineering, architecture, shipbuilding and navigation, yoga, fine arts, chess, and more. Indian culture and philosophy have had a strong influence on the world. These rich legacies to world heritage must be nurtured and preserved for posterity and researched, enhanced, and put to new uses through our education system.” (NEP 2020, p.4. Emphasis added.)</p>	
<b>Learning objectives</b>	<ul style="list-style-type: none"> <li>● Creating awareness among the students about the knowledge heritage and traditions of the country</li> <li>● Provide an understanding and peep into the legacies in Indian culture, philosophy, knowledge creation and practice, developments in Science, Technology, Mathematics, etc.</li> <li>● Political and economic institutions, in health, wellbeing, emotional balance and fulfillment</li> <li>● Encouraging interest in research on Indian knowledge traditions by igniting students’ minds towards India centric research and Exploring Indian wisdom and solutions for applications in solving modern day problems in the society and economy.</li> </ul>	
<b>Course Outcomes</b>	<ul style="list-style-type: none"> <li>● Appreciate the history of the Indian knowledge system and Appraise the importance of Vedas and develop a basic understanding.</li> <li>● Recognise the key role played by Aryabhata and others in the field of mathematics.</li> <li>● Identify the basics of the celestial coordinate system and Develop familiarity with Science, Engineering and Technology heritage of india.</li> <li>● Summarise correlation of body constitution with remedies through traditional medicinal knowledge systems.</li> </ul>	
	<b>THEORY</b>	<b>(30 lectures)</b>
<b>UNIT 1</b>	<b>Module -1 Introduction to IKS -I</b>	<b>8 lectures</b>
1	Meaning and relevance of IKS	1L
2	IKS Corpus-Classification	1L
3	VasudevaKutumbakam- vision for society	1L
4	Indian knowledge Traditions- Indian Epistemological traditions	1L

5	Framework of valid knowledge. Knowledge Triangle	1L
6	The Purpose of Knowledge in India: Para Vidya and Aparavidya	1L
7	Oral traditions-ItihasaPurana traditions	1L
8	Indian Philosophical Traditions- Vedic Schools, Samkhya and Yoga schools, Nyaya and Vaishesika, Vedanta, Non -Vedic Schools	1L
<b>Unit -2</b>	<b>Module 2-Knowledge based Achievements in India's Past</b>	<b>7 lectures</b>
1	Number System, concept of zero in India Ancient Indian Mathematicians and their contributions	1L
2	Indian Science and Technology Heritage-knowledge and prominent works Surgical techniques overview Ayurveda -Definition of health	1L
3	Tri doshas -relation to health Indian psychology-Triguna system States of consciousness	1L
4	Metal technology in India	1L
5	Panini's work on Sanskrit Grammar	1L
6	Governance traditions-Kautilyan State 64 kalas or art forms	1L
7	Unique aspects of Indian Astronomy Indian calendar-Solar and Lunar months Vastushastra traditions	1L
<b>References</b>	<ol style="list-style-type: none"> <li>1. Textbook on IKS by Prof. B Mahadevan, IIM Bengaluru</li> <li>2. Kapur K and Singh A.K (Eds) 2005). Indian Knowledge Systems, Vol. 1. Indian Institute of Advanced Study, Shimla. Tatvabodh of sankaracharya, Central chinmay mission trust, Bombay, 1995.</li> <li>3. The Cultural Heritage of India. Vol.I. Kolkata:Ramakrishna Mission Publication, 1972.</li> <li>4. Nair, Shantha N. Echoes of Ancient Indian Wisdom. New Delhi: Hindology Books, 2008.</li> <li>5. Dr. R. C. Majumdar, H. C. Raychaudhuri and Kalikinkardatta: An Advanced History of India (Second Edition) published by Macmillan &amp; Co., Limited, London, 1953.</li> <li>6. Rao, N. 1970. The Four Values in Indian Philosophy and Culture. Mysore: University of Mysore.</li> <li>7. Avari, B. 2016. India: The Ancient Past: A History of the Indian Subcontinent from c. 7000 BCE to CE 1200. London: Routledge.</li> </ol>	
	<b>Evaluation Scheme</b> Internal assessment (Continuous) of 50 marks	